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METHODS IN GHANAIAN PRIMARY MATHEMATICS TEXTBOOKS AND TEACHERS' CLASSROOM PRACTICE

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ABSTRACT

The official school mathematics curriculum - textbooks, teachers' handbooks, and syllabus - has a powerful influence on classroom practice in a developing country like Ghana, where many teachers with low teaching qualifications hardly ever have access to other sources of information and activity for their teaching. The study, which investigated the congruence between the teaching methods presented in the official curriculum materials and teachers' classroom practice, involved a range of methods – observation of classroom practice, content and discourse analyses of lessons in mathematics. This study has provided further evidence to support the above supposition that the official curriculum has a powerful influence on classroom practice. It found that though there was rhetoric in the introduction of the curriculum materials on the use of discovery teaching methods, the analyses indicated that only few learning/teaching activities that would encourage the use of such discovery methods were included in the materials. It was observed that both the official curriculum and the teachers, who implement it, emphasised expository teaching methods.

INTRODUCTION

Curriculum adaptation at the classroom level may be evidenced by differences between formal curriculum requirements, in terms of content and pedagogy, and the amount of curriculum actually covered during classroom teaching (Smylie, 1994). The implemented curriculum, which is analogous to the content actually taught and the teaching methods employed, is a function of teachers' decisions related to translating formal curricula into specific instructional tasks and activities. The quality and/or appropriateness of the formal curriculum materials therefore can have a considerable influence on teachers' ability to do this successfully, particularly in the least developed countries where many teachers hardly ever have access to other sources of information and activity for their teaching.

The official mathematics textbook schemes used in primary schools in Ghana in the last two decades were originally written with the small intellectual elite, who will proceed to secondary and further education, in

mind (Mereku, 1995). Concerns have been raised about low pupil attainment in the subject which is often attributed to teachers' inability to teach a substantial part of the content of the curriculum. The aim of this study was to investigate the extent to which primary teachers in Ghana translated the contents of the official mathematics curriculum, which was an adaptation of the products of the 'new-math' project spearheaded by the West African Regional Mathematics Programme in the 1970s (Lockard, 1972).

ROLE OF TEXTBOOKS IN THE IMPLEMENTED CURRICULUM

According to Fujita and Jones (2003) various studies, including the Trends in International Mathematics and Science Study (TIMSS), have demonstrated that textbooks, together with documents for use in classrooms as teaching aids, such as resources of exercises, remain important tools in today's classrooms. TIMSS 1999 report indicate that textbooks play an important role in shaping the curriculum experiences of mathematics of pupils in the five to 14 age range. This is particularly apparent in the first few years of formal education, since teachers are usually generalists, rather than mathematics specialists (IEA, 2001). In their study of textbooks in TIMSS countries, Valverde et al (2002) considered that textbooks mediate between intended and implemented curriculum and, as such, are important tools in today's classrooms. Sutherland, Winter and Harris (2001, p155) also suggest "that pupils' construction of knowledge cannot be separated from the multifaceted external representations of this knowledge which envelope the learning pupil." This implies textbooks, one of such representation, can influence what is actually attained from the implemented curriculum.

TIMSS looked extensively at the relationship between the two aspects of the curriculum - the intended and implemented - and how these influence teaching and learning in many countries (IEA, 1995, 1999). These studies revealed dramatic differences in some countries in how much a particular curriculum is taught despite specific mandates about coverage.

ANALYSING MATHEMATICS LESSONS

Lesson analysis is a systematic examination of what actually happens in a teacher's own or another teacher's lesson (Wragg, 1987). Lesson analysis may take several forms. In teacher education programmes, trainees may analyse transcripts of a colleague's lesson to see how the student teacher explains new concepts or deals with pupils' questions. Alternatively they may listen to an audio (or a video) play back of a lesson taught by another

teacher or one of them to examine the types of questions asked by both teachers and pupils. Lesson analysis may involve the use of well designed schedules (or instruments) to determine how often certain teaching behaviours occur in a lesson, or might be more informal or unstructured. Where the analysis is restricted to only verbal interactions between learners and teachers, it is described as discourse analysis.

In order to identify differences between methods prescribed by the official curriculum and those used in teachers' actual classroom teaching, the study used two frameworks for analysing lessons in mathematics. One involved analysis of teachers verbal behaviours described as teaching moves (Jones and Bhalwankar, 1990). The other, addition to the teaching moves, involved type of classroom organisation (Brissenden, 1980). The teaching moves were further subjected to discourse analysis. The approach to the study of classroom discourse used was the one developed at the University of Birmingham, where research initially concerned itself with the structure of classroom discourse (Sinclair and Coulthard, 1975). The Birmingham model is certainly not the only valid approach to analysing discourse. Coulthard, Montgomery, and Brazil (1981) have identified other models that researchers have used in analysing classroom discourse. Nevertheless, only the Birmingham approach was considered in this study not only because it is a relatively simple and powerful model but also because it was, designed for

... classroom situations in which the teacher was at the front of the class 'teaching', and therefore likely to be exerting the maximum amount of control over the structure of the discourse... (Sinclair and Coulthard, 1975).

Messenger (1991) observed one weakness in Sinclair and Coulthard's system for analysing discourse, especially when applied to mathematics lessons. This she explained was that it fails to draw a distinction between pupils' responses which require thought or decisions and those which do not. She identified three types of pupils' responses which she described as *echo*, *routine* and *real*, of which she suggested echo and routine responses do not require thought. Messenger (op cit.) described the three types of responses as

- (i) *Echo* - here the teacher requires the class to echo a word or phrase, or to repeat a response supplied by an individual pupil.
- (ii) *Routine responses* - this includes responses to non-genuine checks of understanding or agreeing with a teacher's statement. ...

- (iii) *Real responses* - requiring thought, understanding, decisions etc.
(Messenger, 1991, p. 53).

In this study, the types of responses elicited by teachers' classroom practice were analysed with respect to the three types of pupils' responses - echo, routine and real.

METHODOLOGY

The Winneba district was used for this study because it had conditions that made its educational provisions typical of that of the whole country, and offered all the opportunities that were required to carry out a survey of this kind. In all 35 teachers in 13 schools in the Winneba district were included in the sample. As the purpose of the study was to analyse the teaching methods presented in both the official curriculum materials and teachers' instruction, the study used a range of methods for data collection. One was content analysis of the official curriculum materials. Another was analysis of teaching moves and discourse patterns in observed lessons. And the third was a survey of teaching skills used in teachers' classroom practice.

The content analysis of the official curriculum materials

The syllabus, textbooks and extracts from the teacher's handbooks were subjected to the content analysis to obtain estimates for the extent of coverage of the intended curriculum. The units of analysis of coverage employed in estimating the extent to which the official curriculum emphasises (or expects teachers to employ) teaching behaviours associated with teaching skills that favour the discovery teaching method were:

- (a) counts of words in the official syllabus describing processes associated with the three stages of mathematical activity- concepts development, skills development, and applications (or using and applying concepts);
- (b) counts of instructions in the teacher's handbook that are likely to induce the three types of classroom organisation – whole class, individual and small group (Brissenden, 1980)
- (c) counts of teaching activities presented in the teacher's handbook that are likely to make pupils learn by discovery.

The Oxford Concordance Programme (OCP) is a computer text analysis software package designed by the Oxford University Computing Service (Hockey and Martin, 1988). The package has several uses including content analysis, stylistic analysis, textual editing, as well as production of full lists, indexes and concordances. To determine counts of words in the official syllabus describing processes associated with the three stages of mathematical activity, the sixty-one-page-official-syllabus document and twenty-two pages of extracts from the teacher's handbook were scanned

onto a computer disc. The OCP was used to produce a concordance, which displays a list of words together with their references and contexts for the selected words. The concordance made it easier for words to be included only in contexts in which they count as teaching activity. The examination of the keywords in contexts was not an easy task. Counts of teaching activities obtained in this way were recorded and the proportion that favoured the discovery learning determined.

Though it cannot be denied that many of the words can be conveniently placed in any of the three stages - concept, skill and applications, stages - a look at the contexts in which these words are presented guide the decision to include each at a particular stage. Below are examples of some the words describing mathematical processes in the syllabus whose teaching contexts were examined to determine the extent to which each stage of mathematical activity is emphasised.

Concept development

Counting, classifying, estimating, matching, ordering, re-naming, sort, sorting, tiling, discover, discovering, discuss, discussion, exploring, extending, guiding, comparing, describing, identifying.

Skill development

Graphing, operations, adding, subtracting, multiplication, dividing, add, subtract, multiply, divide, drawing, measuring, tables, techniques, solve, solving, problems, tell, telling, colouring, colour, collecting, completing, locating.

Applications and problem solving

Environment, game, word problems, games, puzzles, rhymes, riddles, snap, story, tic-tac-toe, guessing, investigating, predict, modelling, relationships.

The classification of words presented above was therefore based on the nature of contexts in which the words mainly appear in the official curriculum. That is, even though a word like ‘measuring’ describes a process that cuts across the three stages, it is used largely for mathematical tasks which require pupils to practise the skill of measuring length and angles using standard units, and the skill of finding equivalencies of units of measurement as well as carrying out computations on these. Counts of processes obtained in this way were recorded for each stage of mathematical activity.

There are three aspects to the activities described in the teacher’s handbooks. These are: the purpose of the activity; materials required in teaching the activity; and instructions to be followed by the teacher in teaching the activity. To determine the types of classroom-exchanges emphasised by the

official curriculum, extracts of instructions in lesson activities in the teacher's handbooks were transcribed to expose the extent to which the teaching activities are likely to make pupils learn by discovery. The transcribed lesson activities were then analysed using the frameworks mentioned above to determine the pattern of lesson presentation suggested by the teaching activities.

Observation and survey of teachers' classroom practice

Teachers were observed in ordinary classroom settings and notes were taken on how the teachers employed the basic moves in teaching the subject. The types of classroom organisation and the contexts created for the presentation of the lessons were also noted. Some of the lessons observed were recorded on audiotapes. These were later played back and transcribed. Also lesson activities suggested in the teachers' handbook were transcribed. The two sets of transcripts were examined for the discourse patterns, types of classroom organisation created.

There was a questionnaire survey of teaching skills used by teachers. The survey was intended to provide information on how often the primary teacher used selected teaching skills in mathematics instruction. Dunkin (1976) argued that two criteria should be applied in judging the validity of technical skills of teaching. The first was the extent to which the specific aspect of teaching behaviour was distinct from other aspects of teaching. The other was the extent to which the skills had been shown to enhance students' learning.

The list of teaching skills included in the questionnaire used in this study were derived from previous studies on effective teaching skills (Cruickshank *et al.*, 1979; Kyriacou, 1982; and Rosenshine, 1979) and modified to expose the use of the discovery teaching method. To ensure the items (or teaching skills) in this instrument could discriminate between teachers who use discovery-teaching methods and teachers who do not, the teaching skills included were those that favour these methods.

Research assistants indicated on a likert-scale from 1 to 3 (i.e. representing-very often, sometimes and never) how often they observed teachers' use of selected teaching skills in mathematics instruction. Half of the skills were consistent with teaching behaviours that promote discovery learning, and so the actual response was recorded for these items. The other half of the items did not directly promote discovery learning, and so these items were scored in reverse (so a response of 1 scores 3 and vice versa).

To ensure each teaching skill was seen as distinct from other aspects of teaching, it was necessary for the research assistants to agree on what constituted the nature of the skill and to be able to identify it when it occurs. To ensure this criterion was met, student-teachers who were used later as research assistants, were assisted to study carefully the questionnaire which was intended to determine how often teachers exhibited particular teaching behaviours in their mathematics teaching. Three different 30-minute video-recorded lessons were presented to the student teachers to observe. At the end of each lesson observed, they rated how often specific teacher behaviours were exhibited using the instrument. This was followed by a discussion of the ratings until consensus was reached on each item. Each student-teacher's ratings on the final video-presented lesson were correlated with the researcher's ratings to determine the inter-rater reliability. Twenty-two of the students for whom high inter-rater reliability (or correlation coefficients of at least 0.7) was recorded, were selected as assistants to administer the questionnaire (Coolican, 1999). It is however important to indicate that the considerable inter-rater reliability obtained is not to deny the existence of conceptual problems in distinguishing between certain forms of teaching skills and therefore the results have to be interpreted with great caution.

RESULTS

Methods prescribed by syllabus and teacher's handbook

As indicated in the methodology, three forms of data were altogether used in determining if the official curriculum emphasised the use of the discovery teaching method. The first was counts of words in the official syllabus related to processes associated with the three stages of mathematical activity- concepts development, skills development, and application of concepts. The second was the number of instructions on teaching activities in the teacher's handbooks suggesting the three common forms of classroom organisation - whole class, individual, and small group. The third was number of instructions on the teaching activities in the teacher's handbooks that are likely to make pupils learn by discovery. The teaching method emphasised by the official curriculum will be discussed first.

Counts of words in the syllabus describing mental processes associated with the three stages of mathematical activity were considered to see the stage(s) of mathematical activity, in respect of those outlined in Brissenden's framework, emphasised by the official curriculum. The proportions of

words found with respect to the three stages- concept development, skill development and applications- are presented in Figure 1.

Words associated with mathematics learning tasks in syllabus

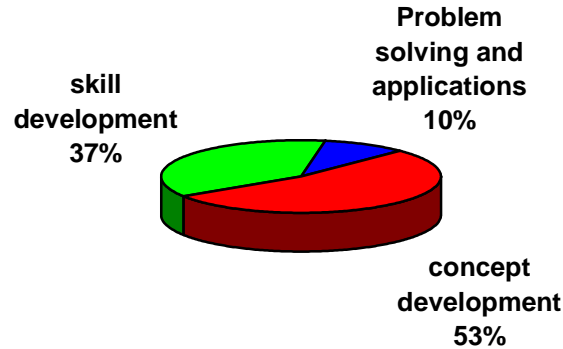


Figure 1 Counts of words associated with mathematics learning tasks presented in the official syllabus

The figure indicates that the mental processes which allow for the development of concepts are the most emphasised. This is followed by processes which allow for the development of skills in computations. It shows that 53% of the words counted as related to the development of concepts which shows that the syllabus emphasises the development of concepts through such processes as counting, classifying, estimating, matching, ordering, re-naming, comparing, describing, and identifying, to mention only a few. Although this is an important attribute of the discovery teaching method this does not necessarily imply the syllabus emphasises this method, therefore the actual teaching and learning activities presented in the teacher's handbooks were systematically examined to see if the concepts have been presented in such a way as to be encountered through discovery.

The instructions in the teacher's handbook, provide detailed guidance on specific actions to be undertaken by the teacher. They also include tasks to be given to pupils and responses to expect from pupils. The instructions suggested on eight lessons (or teaching activities) taken from the Primary 3 teacher's handbook were carefully examined to see how often different patterns of classroom organisation were employed. Figure 2 shows the proportions of instructions found to suggest the organisation of classroom teaching under whole-class, individual and small-group activities.

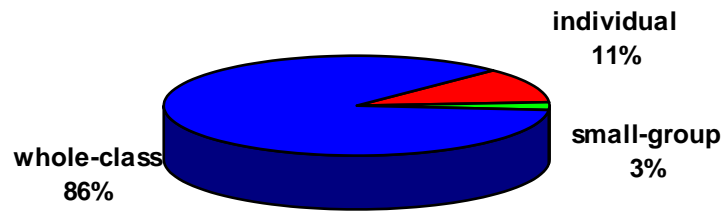


Figure 2 Proportion of instructions in teacher's handbook suggesting classroom organisation under -individual, small-groups, and whole-class

As many as 86% of the instructions (or statements) in the activities examined in the teacher's handbooks require the teacher to operate in whole-class teaching, while only 11% and 3% suggest activities with individuals or small-groups respectively. None of the instructions included teacher-actions like *instigate*, *listen* and *observe* which are useful in directing exploratory activities highly recommended in the introductory part of the syllabus. It can be argued that the official curriculum intends mathematical lessons to be organised mainly in whole-class teaching sessions. Even though concept development is emphasised, this result suggests the concepts are to be learned mainly through whole-class teaching where learners learn concepts by reception rather than discovery.

Furthermore, it was found that the instructions were highly structured towards specific outcomes with no suggestions offered for alternate options, or for methods leading to similar outcomes. It was also found that no suggestions for creative work and investigative work were included. The lack of emphasis on applications and the silence over individual and group work which promote cooperative learning, pupil-directed and small-group learning, indicate that the official curriculum designers did not provide guidance on how and when the discovery method should be used.

The introductory part of the official syllabus and the teacher's handbooks were systematically examined for the method intended to be used in presenting the content recommended in the official curriculum. Two quotations taken from the introductory part of the official syllabus indicate the curriculum developer's position on what constitutes a desirable mathematics teaching method by which pupils should encounter the learning of the content of the curriculum at this level. One is

.... teachers (should) create learning situations and provide guided opportunities for children to acquire as much knowledge and understanding of mathematics as possible through their own activities (CRDD, 1988, p5).

and the other is

There are times when the teacher must show, demonstrate, tell and explain. But the major part of a child's learning experience should consist of opportunities to explore various mathematical situations in his environment to enable him to make his own observations and record them in pictures and/or words. The child would learn to compare, classify, analyse, look for patterns, spot relationships and come to his own conclusions.....

... In the development of concepts, children can be motivated and their interest aroused and maintained through the following stages: PLAY, STRUCTURED EXPERIENCE followed by PRACTICE (CRDD, 1988, p5).

The first quotation suggests that pupils should be made to encounter the learning of the content of the curriculum through their own activities, or by the discovery method. This view is supported in the second quotation by emphasising the key words- *play*, *structured experience*, and *practice*- used by Dienes (1960: p.39), whose writings suggest advocacy of the discovery method, in describing the stages in the learning of a concept.

It is worthwhile noting that even though the quotations include suggestions on teaching skills that are intended to induce acquisition of mathematical knowledge through discovery learning, little mention is made of the word 'discovery' or the expression 'discovery learning' in the whole of the introduction of the syllabus. The introduction to the teacher's handbooks however state that the books are intended "to help pupils to discover the ideas of mathematics so as to enjoy learning the subject" (CRDD 1986). To ensure that pupils are helped to learn by discovery, the handbooks remind teachers that "a teacher teaches best when pupils are made to think for themselves", and recommend that he (the teacher) should "question and guide the pupils but say as little as possible, and he should listen to, and watch the pupils to know when they are ready to move to a new activity or stage".

But despite the rhetoric on the use of discovery method and the frequent use of the word- *discover*- in stating teaching objectives, instructions on teaching activities stated in the handbooks require the teacher mainly to demonstrate correct sequences of steps which lead to a conclusion, but not to engage pupils in the activities for them to arrive at the conclusion. An example of instructions on activities in the teacher's handbook, is the below intended to

be used to guide pupils to discover the relationship between two equivalent fractions.

To discover the idea take pupils through the following activities:

- a) revise with sheets and strips of paper different names for the same fraction (equivalent fractions);
- b) use a number or fractional line as a representation of the paper strip to find the equivalent fractions; and
- c) guide pupils to look for a pattern or similarities in pairs of equivalent fractions like to enable them to recognise their structure.
- d) ask pupils to open their textbooks at bottom of page 110 and complete the sentences in their exercise books

(Extracted from Unit 10 (teaching fractions) in the Primary 3 Teacher's Handbook).

In this activity, pupils are expected to realise a mathematical structure as their conclusion. The structure can be described as any fraction, (for instance, $\frac{a}{b}$), another fraction equal to it can be obtained when the numerator and denominator are multiplied by the same number. And if c is the number used as the common multiplier, then the required structure can be symbolically expressed as $\frac{a}{b} = \frac{a \times c}{b \times c}$.

The activities suggested in the instructions above indicate that this complex relationship is to be learned from teacher-led exposition and not by pupils' own discovery. Pupils' activity was mentioned only in the fourth instruction, and even in this case, it was an activity which involves pupils' individual practice, or what is termed by some teachers as seat work.

In the light of the sense in which the term discovery is used in the teacher's handbooks, it can be argued that the curriculum designers confuse its meaning with that of 'meaningful reception'. That is, the form of learning experienced by pupils when the teacher's exposition allows new learning materials taught to be both assimilated and interconnected with what already exists in pupils minds. The results of the analysis of the official syllabus and the teacher's handbooks strongly suggest that the learning and teaching activities recommended in the official curriculum favour the expository teaching method. The evidence therefore suggests that the designers of the curriculum did not really have a clear concept of how the curriculum might be presented by the discovery teaching method.

Methods used in teachers' classroom practice

Teachers' use of the discovery teaching method in their classroom practice was examined in terms of 'how often teaching skills that increase the chances of the pupils' discovery' - were used in instruction. As explained above, two supplementary processes were used to obtain the frequencies of teachers' use of these teaching skills. One was through observation and rating by trained assistants, and the other was by analysis of tape-recorded lesson transcripts. In the lesson transcripts analysis, the emphasis on the discovery method was considered in terms of the types of discourse patterns and nature of pupils' responses involved in the observed lessons.

The success in fostering inquiry and guiding discovery in the classroom in terms of the teacher's use of certain presentation skills. The proportion of teachers found never using these skills, and those found using them occasionally or often, are presented in Table 1.

Table 1. Teachers' use of skills likely to induce learning by discovery

Teaching skills	Percentage of Teachers Indicating		
	Never	Occasionally	Often
Giving meaningful answers to pupils' questions	82.9	2.4	14.6
Using approaches that bring conceptual understanding	18.2	63.6	18.2
Encouraging pupils to use their own methods in solving problem	95.5	4.5	0
Using mainly textbook examples and exercises	2.3	0	97.7
Using methods which do not encourage discussion	11.6	9.3	79.1
Teaching challenging mathematics only from textbooks	0	29.5	70.5
Preparing and using teaching/learning material in lessons	45.5	54.5	0
Setting and marking of homework	58.1	34.9	7.0
Engaging pupils in practical and game activities in lessons	68.2	31.8	0

The infrequent use of teaching and learning materials, practical and game activities, can be seen in the table. The table shows 45.5 per cent of the teachers were found to be teaching without teaching/learning materials; 68.2 per cent of them presented lessons without engaging the pupils in practical tasks and games. Though 55 per cent of indicated they occasionally used teaching/learning material, these were largely materials that were conveniently within their reach in and around the classroom or "opportunity aids". Examples of such opportunity aids are the pupils themselves,

windows, doors, tables, chairs, objects on and around the compound like trees, paths, lawns, houses, animals and passing vehicles.

Just about 17 per cent of the teachers were found to have provided meaningful answers to pupils' questions mainly because many of the teachers hardly engaged pupils in activities that will urge them to ask questions. Though about 70 per cent of the teachers were found to be teaching challenging mathematics, as many as 98 per cent of them were found using solely examples and exercises set in the official textbooks. The table also shows that the majority of teachers instructed pupils to use only the standard textbook methods irrespective of their abilities. An inspection of pupils' exercise books during the researchers' visits to schools revealed that exercises set by teachers involved mainly those that gave practice in number computations. In other words, routine tasks involving mainly skill exercises were the learning tasks most frequently presented in teachers' instruction.

Table 2 shows the proportion of classroom exchanges recorded in three tape-recorded lessons under the four types of classroom exchanges - eliciting, informing, directing and checking.

Table 2 Classroom exchanges from transcripts of three tape-recorded lesson extracts

	Number of exchanges judged			
	Elicit	Inform	Direct	Checking
Lesson 1 (Age 12)				
count	24	3	7	2
	(67%)	(8%)	(19%)	(5%)
Lesson 2 (Age 6)				
count	10	1	3	0
	(71%)	(7%)	(21%)	(0%)
Lesson 3 (Age 9)				
count	25	3	2	1
	(80%)	(10%)	(6%)	(3%)

Teacher-led elicit exchanges with responses either from an individual or a large number of pupils in a class was the most common form of classroom exchange observed. In all three lessons this, together with teacher-led inform exchanges, constituted more than 70% of the exchanges. That is, the teachers used mainly exchanges that elicit verbal information regarding mathematical principles being learned, as in the extract below.

(Teacher asked two groups standing in front to take their seats.



She draws two sets with a 'U' sign between them on board).

133: Teacher: How many members are in this set?
(pointing to the set on the left) Yes Botse?

134: Pupil (B): three

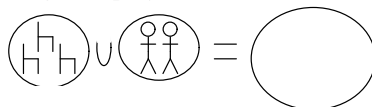
135: Teacher : Good

136: Teacher : How many members are in the other set? ...

137: Pupilj : two

138: Teacher : Fine. You eh, Joyce.

(Teacher wrote an equal sign to the right of the sets on the board and drew a large loop after it).



139: Teacher: If we have a third set, (pointing to the loop), a big set, and bringing together the two small sets, how many members shall we have in the big set?..

140: Class: [responses which were not clearly audible from the tape].

The other forms of exchanges- directing and checking exchanges,- whose use can make pupils more likely to encounter the learning of the mathematical principles by discovering by themselves, constituted just under a quarter of the exchanges recorded in each lesson.

Observed pupils' verbal responses were also classified using the three categories used by Messenger (1991) - echo, routine and real responses and by considering whether they were given by pupils speaking in chorus, pupils speaking simultaneously or by an individual pupil. Even though the classification of responses in the tape-recorded lessons into the three categories required some amount of subjectivity, the analysis presented in Table 3 provide some indication of the nature of 'pupil participation' in the lessons.

Even though substantial proportions of the pupils' responses in the lessons analysed were real (that is based on thought and decision), they were mainly made by the same few individual pupils who were the focus of most of the teacher's contact with the class. Usually, these individuals constituted a minority of the class and they were the few more able pupils who were able to follow the teacher's instruction and who also dictated the pace of the teacher's presentation. Most of the responses were often in the form of short phrases used in expressing agreement with the teacher or a single word used

in expressing the answer to a question. Hardly ever did the responses entail full sentences.

Table 3 Analysis of pupils responses in classroom exchanges

Nature of Response	Choral	Simultaneous	Individual	Total
Echo				
Lesson 1 (p.6)	5	0	0	5 (11%)
Lesson 2 (p.1)	0	0	0	0 (0%)
Lesson 3 (p.3)	11	0	0	11 (38%)
Routine				
Lesson 1 (p.6)	4	0	0	4 (8%)
Lesson 2 (p.1)	2	0	0	2 (12%)
Lesson 3 (p.3)	3	2	0	5 (17%)
Real				
Lesson 1 (p.6)	14	2	23	39 (82%)
Lesson 2 (p.1)	1	2	12	15 (88%)
Lesson 3 (p.3)	4	1	8	13 (45%)
Total				
Lesson 1 (p.6)	23 (48%)	2(4%)	23 (48%)	48 (100%)
Lesson 2 (p.1)	3 (18%)	2(12%)	12 (70%)	17 (100%)
Lesson 3 (p.3)	18 (62%)	3(10%)	8 (28%)	29 (100%)

For most of the pupils however, the only form of participation in the classroom discourse was through choral responses. These responses, though they were real, were mainly those that require less thought, like recognition of terms, symbols, notations and fractions or counts of sets of objects. Simultaneous responses occurred but usually in exchanges in which the teacher delayed in deciding who should answer a question or carry out his or her request. The exchange patterns and nature of pupils' responses indicate that teachers hardly ever engage pupils in small-group activities.

Mathematics lessons in most classrooms visited followed a similar pattern. There was little difference in the sequence of presentation, form of classroom organisation and classroom discourse patterns. The sequence of presentation generally followed the pattern that can be described as 'teacher-led class discussion using situations and examples, followed by pupils' examples and exercises.

DISCUSSIONS

Teachers' handbooks to pupils' textbooks and the syllabus have general guidelines on the implementation of the curriculum. They both stress that teachers should use investigational or activity methods which are directed towards learning tasks that will encourage inquiry, creativity, and

manipulative and manual skills. But the explanations and descriptions given to these methods tend to confuse classroom teachers with those intended to induce learning by discovery (Mereku, 1995).

This confusion is due partly to the rhetoric on the use of teaching skills that suggest investigational or activity method in the introductory part of the curriculum materials, which themselves provided little variety of activities that can induce such learning. Though there was frequent use of the word-*discover*- in stating teaching objectives of the content prescribed in the syllabus and teachers' handbooks, the activities that followed were presented in ways that encourage teachers to teach by exposition. It can therefore be argued that both the official curriculum and the teachers who implement it emphasised the expository teaching method.

IMPLICATIONS FOR CURRICULUM DEVELOPERS AND IMPLEMENTERS

The above results suggest the curriculum designers may not have intended the discovery method to be used in its implementation, or may not have appreciated how it might be used. The rhetoric on the use of the discovery method in the official curriculum materials must therefore be interpreted with great caution.

Teachers are generally conservative with regard to curricular change, and are most receptive to proposals for change that fit with their classroom procedures and do not cause major disruptions. Research has also not convincingly shown that any pattern of teaching behaviour leads consistently to better learning (Kilpatrick, 1978). Also Guthrie's (1990) has suggested that "the teaching process in schools, particularly in developing countries, can be improved by helping teachers to improve the traditional expository styles". In view of these, it will not be very efficient to expect teachers to shift radically to the discovery teaching methods bearing in mind that the current curriculum materials encourage the use of expository teaching method which is used often by most teachers.

Curriculum developers and implementers must note that in the least developed countries, where many teachers with low teaching qualifications hardly ever have access to other sources of information and activity, textbooks will continue to play a major role in what goes on in the classroom. Taking account of the power of the textbook in determining what is taught, and how it is taught, it is likely that the textbook and teacher's handbook will remain a major resource in the classroom. Textbook writers should therefore ensure their products communicate the

methods they really intend teachers to use in the delivery of the content they put in their materials.

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